

Universal Keypad

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Keypads are needed for a variety of applications and DIY projects. Particularly for selecting the measurement range of an instrument or setting the output voltage of a laboratory power supply, as well as for many other uses, potential-free relay outputs are desirable. In addition, break-before-make switching should be used to avoid short circuits. This cannot be guaranteed by simple relay circuits, since the pull-in speed of most relays is greater than the dropout speed!

In many cases, an expensive or hard-to-obtain special-purpose IC is used for this purpose, but most such ICs limit the number of keys that can be used, and break-before-make switching is often an unheard-of luxury! The circuit shown here, which is about as simple as possible and can be built using only a handful of parts from your 'junk box', shows that there are other ways to solve this problem.

This design has the following advantages:

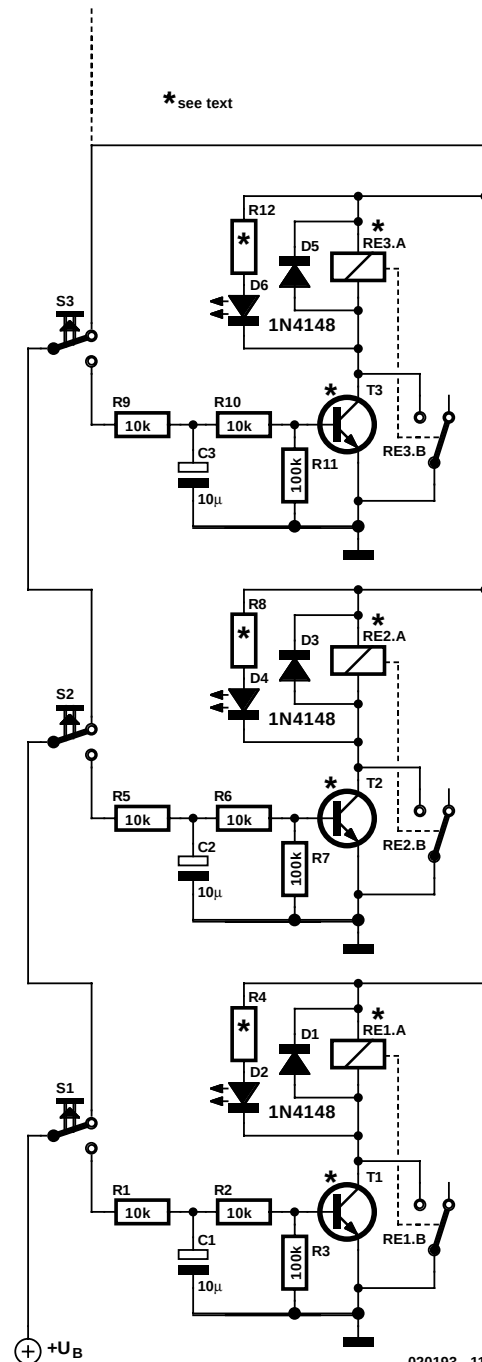
- break-before-make operation
- potential-free relay outputs
- any desired number of keys
- any desired operating voltage
- well-defined initial state (all relays disengaged)
- only one stage switches if multiple keys are pressed

Each of the relays must have a spare working contact for the changeover function. The pushbutton switches must have changeover (double-throw) contacts that can switch the coil currents of the relays. If the current rating of the pushbutton switch contacts is insufficient (particularly with high-power circuitry), a small relay can be connected in series with the switch to supply power to the load relay.

Operating power is supplied to the switching stages via a series connection of the normally-closed (nc or 'break') contacts of all of the pushbutton switches. When any one of the switches is actuated, the supply voltage to all stages is interrupted, causing all of the relays to drop out, and the base capacitor associated the actuated switch is charged. When the switch is released, power is again applied to all of the relay stages, but only the capacitor of the selected switching stage provides sufficient energy to drive the connected transistor into conduction and engage the relay. The working contact of the relay latches the relay. LEDs with series resistors connected in parallel with the relay coils indicate their switching states.

When a different key is pressed, the above process is repeated. First, the supply voltage is disconnected from all of the relays, which ensures break-before-make operation. When the key is released, the relay whose capacitor has been charged is actuated.

If several keys are pressed at the same time, only one capacitor receives a charging voltage. This is the capacitor for the only pushbutton switch in the series circuit that is still connected to the positive terminal, which means the first switch



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in the series. This ensures that only one stage can switch. The values of the components marked with a * must be chosen to match to the supply voltage used or the required switching current. If power relays are used, Darlington transistors with suitable power ratings should be used. The number of switching stages can be extended to almost any desired limit to allow you to fit your equipment with a convenient, reliable keypad.

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